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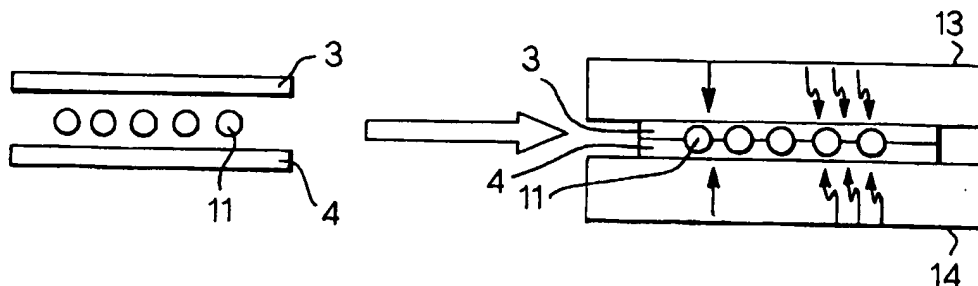
(43) International Publication Date
7 November 2002 (07.11.2002)

PCT

(10) International Publication Number
WO 02/088813 A1

- (51) International Patent Classification⁷: **G02B 6/42**
- (21) International Application Number: PCT/GB02/01745
- (22) International Filing Date: 15 April 2002 (15.04.2002)
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data:
0110366.2 27 April 2001 (27.04.2001) GB
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- (81) Designated States (national): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, OM, PH, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZM, ZW.
- (84) Designated States (regional): Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR).
- Declaration under Rule 4.17:**
— of inventorship (Rule 4.17(iv)) for US only
- Published:**
— with international search report
- For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: OPTICAL FIBRE SEALING



(57) Abstract: A method is provided for sealing a container (10) into which optical fibres (11) are fed. A portion of the optical fibres (11) is accommodated between two strips (3, 4) which are sealed together by applying heat and/or pressure. The strips are then placed in an opening of the container and the container is sealed. The strips (3, 4), which may be made of plastic, support the fibres (11) while providing an excellent seal.

OPTICAL FIBRE SEALING

The present invention relates to optical fibre sealing. More in particular, the present invention relates to a method of and a device for sealingly enclosing a space into which one or more optical fibres or cables are fed.

5 It is well known that moisture has adverse effects on the properties of optical components. The split ratio of optical splitters, for example, may be influenced by the presence of moisture, and in optical connectors moisture may lead to increased losses. The sealing of optical components against moisture and other environmental influences, in other words environmental sealing, is therefore highly desirable.

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It has been proposed to environmentally seal individual optical components. This is, however, expensive and not always effective.

In the case of electrical or electronic components it is known to seal an entire circuit
15 by enclosing it in a flexible, moisture-resistant bag. WO 94/18815 (Ericsson), for example, discloses a casing for flexibly enclosing electronic circuitry. The casing comprises a laminate consisting of metal and plastic sheets. Two sheets of laminate are joined to form an envelope in which electronic circuitry may be accommodated. Electrical conductors pass through the joint region of the laminate.

20

Although such an arrangement may be effective for sealing electronic circuits, it is less suitable for optical components or circuits. The present inventors have found that optical fibres, unlike electrical conductors such as copper wires, should not be passed through the joint region of the laminate without additional measures. Copper wires (or other electrical
25 conductors) may be bent under almost any angle without affecting their conductive properties. Optical fibres however, while being more flexible than copper wires, should not be bent under the minimum bending radius at which light losses occur (usually approximately 3 cm), and certainly not under the minimum bending radius at which they suffer permanent damage. In addition, optical fibres are made of glass which has different sealing properties to
30 metal.

- 2 -

It is therefore an object of the present invention to provide a method of sealing elongate objects entering a closure which avoids the problems of the Prior Art and which is particularly suitable for optical fibres.

5 It is another object of the present invention to provide a method which is relatively simple and economical.

It is a further object of the present invention to provide a method which can be used for different types of closures, both rigid and flexible closures.

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It is a yet further object of the present invention to provide a device for enclosing a space into which optical fibres are fed, and a kit-of-parts for forming such a device.

Accordingly, the present invention provides an assembly sealingly enclosing a space
15 into which one or more optical fibres and/or optical cables is or are fed, the assembly comprising a container having an opening, one or more optical fibres and/or cables extending throughout the said opening into the said container, and a sealing member sealingly enclosing the said fibres or cables and sealing the said opening, the sealing member comprising two
20 sealing strips heat-and/or pressure-sealed together around the said fibres and/or cables extending between the said strips and heat-and/or pressure-sealed to the container to seal the said opening onto the said strips.

The present invention also provides a method of sealingly enclosing a space into which one or more optical fibres and/or optical cables is or are fed, which method comprises
25 the steps of providing a container having an opening, providing two sealing strips, accommodating a portion of one or more optical fibres and/or cables between the two sealing strips, applying heat and/or pressure to the strips so as to produce a sealing member which sealingly encloses the fibres and/or cables, placing the sealing member in said opening, and applying heat and/or pressure to the container so as to seal said opening onto the strips.

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Conceivably, the container could be provided with the sealing strips pre-sealed to opposed surfaces of the opening, ready to receive and seal around the fibres and/or cables.

- 3 -

By sealingly enclosing a portion of the optical fibres and/or cables between two sealing strips the fibres are supported over part of their length, thus preventing excessive bending of the fibres and facilitating their handling. In addition, a good seal can be obtained by applying heat/and or pressure. By subsequently sealing the edges of the container opening onto the strips, an excellent seal can be obtained. Alternatively, the edges of the container opening are sealed onto the strips when the strips are sealed together.

It will be understood that the container may consist of, for example, two sheets of laminate, the edges of which may not be joined until these sheets are sealed onto the sealing strips. Alternatively, a tubular container may be used having openings at both ends, one or both of which may be provided with a pair of sealing strips.

The sealing strips are preferably made of plastic, so that they soften when heat is applied. This allows the optical fibres to be embedded in the pair of strips.

Advantageously, the sealing strips are provided with a layer of hot-melt adhesive. This adhesive may be applied on the sides of the strips facing the other strips, and/or on the sides facing the edges of the container opening.

Preferably, the said portion of the at least one optical fibre extends substantially transversely to the longitudinal direction of the strips. This is particularly advantageous when a plurality of optical fibres is accommodated, which can be arranged in parallel along the length of the strips.

In a preferred embodiment the strips have an effective width of at least 1 cm, preferably at least 2 cm. The width of the strips defines the maximum effective sealing length of the optical fibres and a minimum sealing of a few millimetres is required. It will be understood that the greater the overlapping width of the strips, the greater the effective sealing length of the fibres.

- 4 -

The strips preferably have sufficient rigidity to resist bending of the optical fibres. Although rigid strips may be used, strips having some flexibility are preferred. In the case of plastic strips, a thickness of about 0.2 to 2.0 mm is preferred, although other thicknesses are also possible. The length of the strips may be determined by the size of the container opening.

The present invention further provides a device for sealingly enclosing a space into which at least one optical fibres if fed, the device being produced by the method as defined above. The present invention further provides a kit-of-parts for forming such a device. The device of the present invention comprises a container or container parts, and two sealing strips for accommodating optical fibres between them.

The present invention will be further discussed below with reference to exemplary embodiments illustrated in the accompanying drawings, in which:

Figure 1 shows, in cross-sectional view, a device for enclosing electronic circuitry according to the Prior Art;

Figure 2a and 2b show, in cross-sectional view, how optical fibres are sealed in accordance with the present invention;

Figure 3 shows, in perspective, a tray for optical components in accordance with the present invention;

Figure 4 shows, in perspective, the tray of Fig. 3 with sealed fibres;

Figure 5 shows, in perspective, the tray of Figs. 3 and 4 enclosed in a container.

Figure 6 shows, in perspective, the sealing strips in use on buffered fibres;

Figure 7 shows, in perspective, the sealing strips in use on a ribbon cable;

Figure 8 shows, in perspective, the sealing strips in use on a reinforced cable.

The Prior Art device 20 shown in Fig. 1 is constituted by a flexible bag which consists of two laminated sheets 21. The sheets are joined in joint regions 22. A printed circuit board (PCB) 25 is contained in the device 20. Electrical conductors 26 pass directly through one of the joint regions 22 without any additional support. This device is disclosed in the aforementioned International Patent Application WO 94/18815.

- 5 -

It is schematically shown in Figs. 2a and 2b how optical fibres are sealed in accordance with the present invention. Fibres 11 are accommodated between sealing strips 3 and 4, as shown in Fig. 2a. In a next step, as shown in Fig. 2b, the sealing strips 3, 4 and the fibres 11 sandwiched between them are accommodated between two plates 13 and 14. Heat and/or pressure, preferably both is applied, causing the sealing strips 3, 4 to change shape and to sealingly surround the fibres 11. When made of plastic, the sealing strips 3, 4 may melt slightly, resulting in a good mutual bond and a good bonding with the optical fibres. An even better bonding with the fibres may be obtained when their cladding is removed prior to being accommodated between the sealing strips.

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It will be understood that the fibres 11 and the sealing strips 3, 4 extend in parallel over some distance perpendicular to the plane of the drawing. The portion of the length of the fibres sealingly enclosed by both strips defines the effective sealing length of the fibres.

15 The tray 6 shown in Fig. 3 is suitable for accommodating optical components and/or optical circuitry. Optical fibres 11 lead into the tray. Underneath the tray 6 a (relatively rigid) sheet 7 is mounted. The sheet 7 extends beyond the tray 6 so as to leave a first strip 3 which supports the optical fibres.

20 In accordance with the present invention, a second strip 4 is placed upon the first strip 3 so as to enclose the fibres 11 in the manner shown in Fig. 2. As shown in Fig. 4, the second strip 4 may have a smaller width than the first strip 3, leaving a transition region 9 which serves to accommodate any difference in height between the first strip 3 and the plane of the tray 6. In this transition region 9, suitable bend control means (not shown) may be located.

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The container 1 shown in Fig. 5 is a flexible bag, preferably made of an aluminium/polyethylene laminate. Laminates of this kind are, for example, used in Raychem's TDUX™ products, as disclosed in EP 0 579 641 and other patents. The bag has an opening 2, the edges of which are sealed at the strips 3, 4 thus providing an excellent seal. The resulting device 10 sealingly encloses the space defined by the tray 6 and may contain optical components and/or an entire optical circuit.

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- 6 -

Figures 6, 7 and 8 show the way various fibre optic cable constructions may be terminated in a sealing strip according to the invention to achieve both a good moisture barrier level, mechanical protection and strain relief. Fig. 6 shows secondary coated fibre (buffer tube) 60 that is embedded in the polymer strip 62. This buffer tube can be unfilled or filled with grease or silicone sealant for example. To create an improved sealing level the buffer tube 60 is stripped off over a certain distance. The transition point between buffer 60 and primary coated fibre 64 is embedded in the strip to prevent moisture from leaking through the secondary tube 60. The primary coating may optionally be removed to expose the uncoated fibre 66. A second benefit is the mechanical protection of the transition area that is more fragile to mechanical movement. A third benefit of this embedded termination is a strain relief function when a fibre is pulled.

In Fig. 7 the termination of a ribbon fibre assembly 70 is shown. A ribbon is a flat cable assembly of several optical fibres 72. These are primary coated fibres that are over coated to group these fibres. This ribbon coating is often not strongly bonded to the primary coated fibres to allow removal of the coating for better handling of single fibres. Several moisture leak paths can be present between the over coating and the fibres. To achieve a good sealing these leak paths are blocked when the coating is removed over a certain distance and this is embedded in the sealing strip 74. Again mechanical protection of the transition and strain relief of the fibres and ribbon is achieved.

Also reinforced cable constructions like patch cords, indoor cable subunits, for example, can be terminated in a strip according to this invention. In Fig. 8 a patch cord termination is shown. To achieve a good sealing, the cable assembly 80 is stripped down to expose the buffer 82, strength members 84, and the primary coated fibre 86 and the resulting transition zone is embedded. To generate a higher strain relief level the strength members 84 can be embedded in the strip 88 for fixation. When the cable is pulled the stresses will be passed to the strength members without affecting the fibres. To get an even higher sealing level the primary coating can be removed from a fibre over a certain distance before embedding as shown for one of the fibres in Fig. 6. This is optional but not essential to achieve a good sealing level.

- 7 -

It will be understood by those skilled in the art that the present invention is not limited to the embodiments shown and that many additions and modifications are possible without departing from the scope of the present invention as defined in the appending claims.

Claims

1. An assembly sealingly enclosing a space into which one or more optical fibres (10) and/or optical cables (70, 80) is or are fed, the assembly comprising:
 - 5 a) a container (1) having an opening (2),
 - b) one or more optical fibres (10) and/or cables (70, 80) extending through the said opening into the said container, and
 - c) a sealing member (5) sealingly enclosing the said fibres or cables and sealing the said opening, the sealing member comprising two sealing strips (3, 4) heat-
10 and/or pressure-sealed together around the said fibres and/or cables extending between the said strips and heat-and/or pressure-sealed to the container to seal the said opening.
2. Method of sealingly enclosing a space into which at least one optical fibre (10) is fed,
15 the method comprising the steps of:
 - a) providing a container (1) having an opening (2),
 - b) providing two sealing strips (3, 4),
 - c) accommodating a portion of at least one optical fibre (11) between the two sealing strips (3, 4),
 - 20 d) applying heat and/or pressure to the strips (3, 4) so as to produce a sealing member (5) which sealingly encloses the at least one fibre (11),
 - e) placing the sealing member (5) in said opening (2), and
 - f) applying heat and/or pressure to the container (1) so as to seal said opening (2) onto the strips.
- 25 3. Method according to claim 2, wherein step e) is carried out before step d), and wherein steps d) and f) are carried out substantially simultaneously.
4. Assembly according to claim 1 or method according to claim 2, wherein the container
30 (1) is substantially rigid.

- 9 -

5. Assembly according to claim 1 or method according to claim 2, wherein the container (1) is substantially flexible.
6. Assembly or method according to claim 5, wherein the container (1) is constituted by a bag made of laminate comprising aluminium.
7. Assembly or method according to any of the preceding claims, wherein the sealing strips (3, 4) are made of plastic.
8. Assembly or method according to any of the preceding claims, wherein the sealing strips (3, 4) are provided with a layer of hot-melt adhesive.
9. Assembly or method according to any of the preceding claims, wherein the said portion of the at least one optical fibre (11) extends substantially transversely to the longitudinal direction of the strips (3, 4).
10. Assembly or method according to any of the preceding claims, wherein a plurality of optical fibres (11) is accommodated between the two sealing strips (3, 4).
11. Assembly or method according to claim 8 or 9, wherein the strips (3, 4) have an effective width of at least 1 cm, preferably at least 2 cm.
12. Container for sealingly enclosing a space into which one or more optical fibres (11) and/or optical cables (70, 80) is or are fed, the container (1) having an opening (2) with sealing strips (3, 4) respectively pre-sealed to opposed surfaces of the said opening ready to receive therebetween and to seal around the said fibres and/or cables.
13. Container (1) according to claim 11, containing optical components.
14. Kit-of-parts for forming a device according to claim 11 or 12.

* * * * *

Fig.1. PRIOR ART.

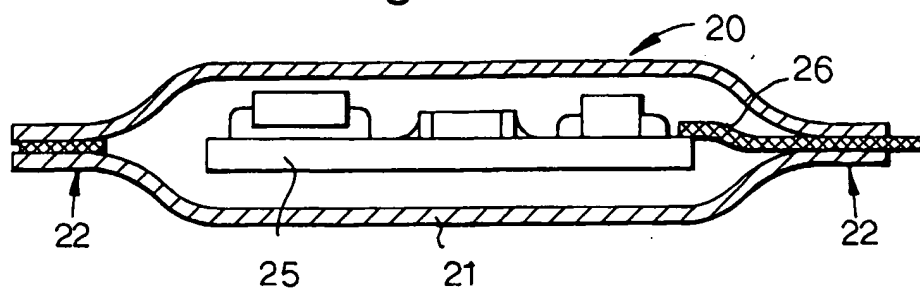


Fig.2a.

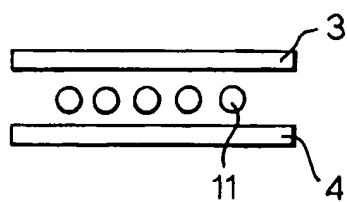
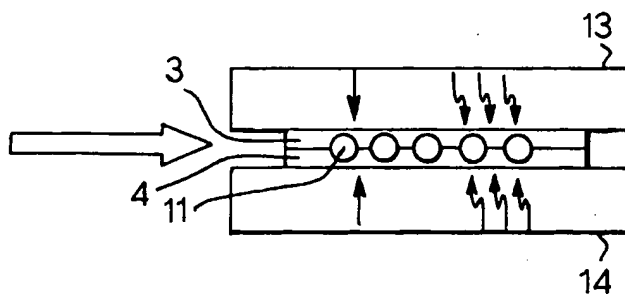


Fig.2b.



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Fig.3.

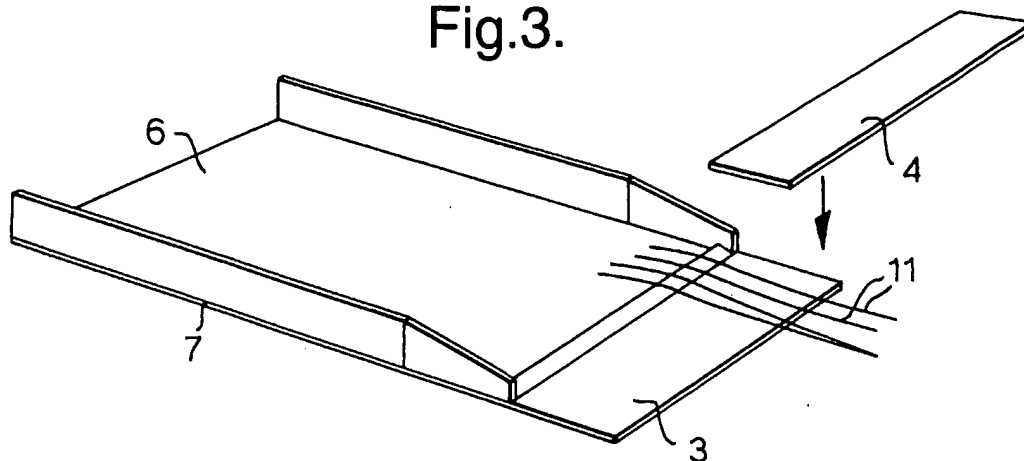


Fig.4.

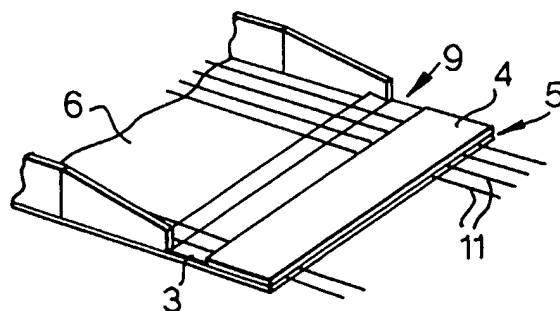


Fig.5.

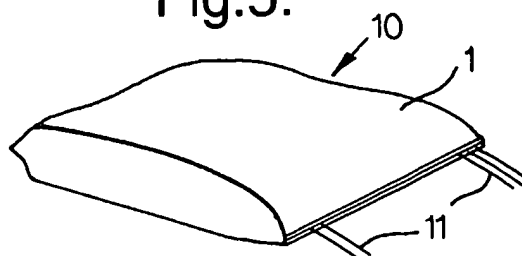


Fig.7.

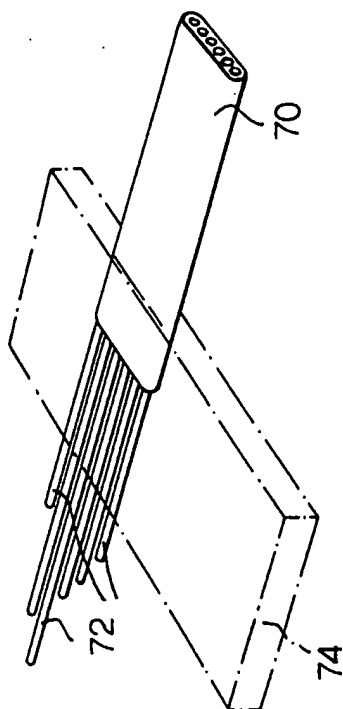


Fig.6.

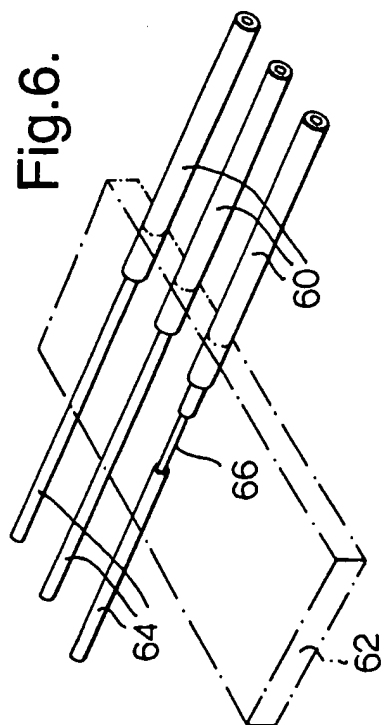
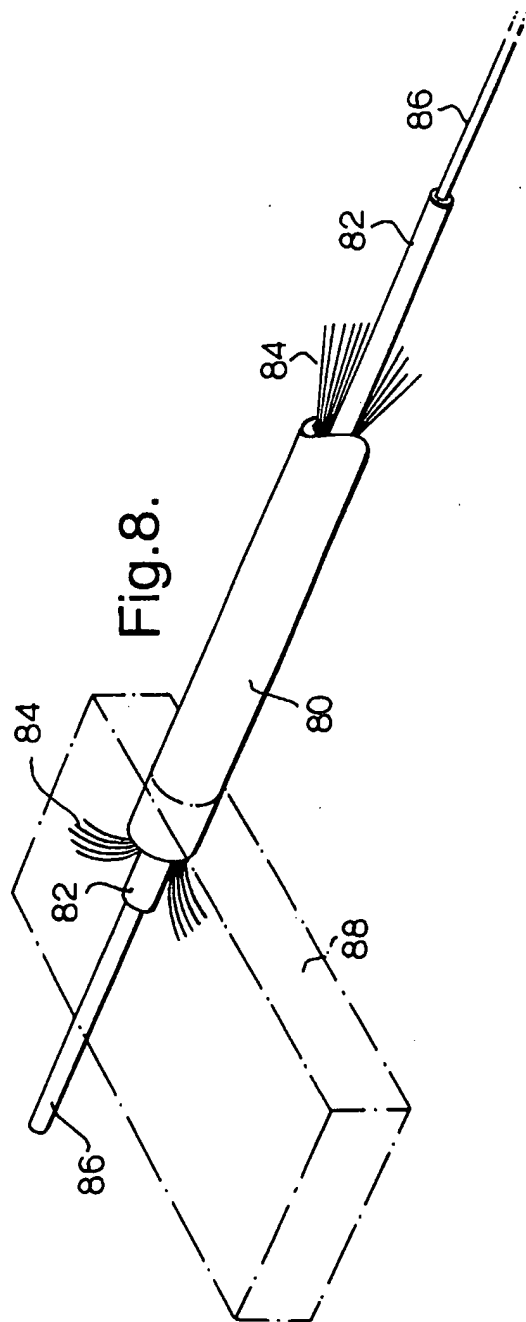


Fig.8.



INTERNATIONAL SEARCH REPORT

National Application No

PCT/GB 02/01745

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 G02B6/42

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 G02B H02G

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, PAJ, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 98 21801 A (MINNESOTA MINING & MFG) 22 May 1998 (1998-05-22) page 3, line 29 -page 7, line 26; figures 1-4	1,2,4,7, 9-14
X	--- PATENT ABSTRACTS OF JAPAN vol. 2000, no. 13, 5 February 2001 (2001-02-05) -& JP 2000 292642 A (NIPPON TELEGR & TELEPH CORP ;NTT ELECTRONICS CORP), 20 October 2000 (2000-10-20) abstract --- -/--	1-3,5-7, 9,10, 12-14



Further documents are listed in the continuation of box C.



Patent family members are listed in annex.

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Date of the actual completion of the international search

13 August 2002

Date of mailing of the international search report

21/08/2002

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INTERNATIONAL SEARCH REPORT

International Application No

PCT/GB 02/01745

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4 954 670 A (JENSEN MICHAEL LIND ET AL) 4 September 1990 (1990-09-04) column 3, line 43 - line 49 column 11, line 53 -column 12, line 9; figures 2A,2B column 12, line 56 - line 60 column 13, line 18 - line 53; figures 3,4 ---	1-6,9, 12-14
X	WO 98 01783 A (AKZO NOBEL NV ;THACKARA JOHN INGALLS (US)) 15 January 1998 (1998-01-15) page 6, line 4 -page 8, line 2; figures 1,2 ---	1-4, 12-14
X	PATENT ABSTRACTS OF JAPAN vol. 1995, no. 06, 31 July 1995 (1995-07-31) - & JP 07 063956 A (NEC CORP), 10 March 1995 (1995-03-10) abstract ---	1-4, 12-14
X	US 5 416 873 A (HUEBSCHER LASZLO ET AL) 16 May 1995 (1995-05-16) column 3, line 14 -column 5, line 2; figures 1-4 ---	1,2,4,7, 8,12-14
X	US 4 135 587 A (DIAZ STEPHEN H) 23 January 1979 (1979-01-23) abstract; figure 1 column 7, line 1 - line 13; figures 2,3 ---	1-4,8, 12-14
X	US 5 568 584 A (SMITH DONALD J) 22 October 1996 (1996-10-22) abstract column 7, line 1 - line 14; figure 4 column 8, line 17 - line 29; figure 7 ---	1
X	DE 78 16 729 U (RITTAL-WERK RUDOLF LOH GMBH & CO KG) 28 September 1978 (1978-09-28) page 5, last line -page 6, line 5; figure 1 -----	1

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/GB 02/01745

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
WO 9821801	A	22-05-1998	AU 2526997 A WO 9821801 A1	03-06-1998 22-05-1998
JP 2000292642	A	20-10-2000	NONE	
US 4954670	A	04-09-1990	AT 88302 T AU 633068 B2 AU 5316990 A AU 598791 B2 AU 6920587 A BR 8700857 A CA 1276036 A1 CN 87102262 A DE 3785376 D1 DE 3785376 T2 DK 91587 A EP 0236056 A2 JP 62225117 A NO 870754 A TR 23069 A	15-04-1993 21-01-1993 16-08-1990 05-07-1990 27-08-1987 29-12-1987 06-11-1990 21-10-1987 19-05-1993 02-12-1993 25-08-1987 09-09-1987 03-10-1987 25-08-1987 21-02-1989
WO 9801783	A	15-01-1998	AU 3442297 A CA 2259971 A1 WO 9801783 A1 EP 0909400 A1 JP 2001508184 T AU 3730097 A CA 2230284 A1 EP 0850402 A1 JP 2001514737 T WO 9800696 A1	02-02-1998 15-01-1998 15-01-1998 21-04-1999 19-06-2001 21-01-1998 08-01-1998 01-07-1998 11-09-2001 08-01-1998
JP 07063956 2	A		NONE	
US 5416873	A	16-05-1995	NONE	
US 4135587	A	23-01-1979	AU 513231 B2 AU 2035376 A BE 849187 A1 CA 1084130 A1 DE 2655534 A1 ES 454064 A1 FR 2335078 A1 GB 1571895 A HK 69880 A IT 1065033 B JP 52092393 A	20-11-1980 15-06-1978 08-06-1977 19-08-1980 23-06-1977 01-12-1977 08-07-1977 23-07-1980 19-12-1980 25-02-1985 03-08-1977
US 5568584	A	22-10-1996	US 5835658 A US 5825961 A US 5793920 A US 5793921 A	10-11-1998 20-10-1998 11-08-1998 11-08-1998
DE 7816729	U	28-09-1978	DE 7816729 U1	28-09-1978